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Health and wellness for disadvantaged older adults: The AFRESH pilot study

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ABSTRACT

Introduction: Older adults are unaware of the biological mechanisms that contribute to the development of disabilities, chronic conditions, and frailty, yet, when made aware, desire to employ lifestyle changes to mitigate these conditions. We developed the AFRESH health and wellness program and report on pilot testing undertaken in a local older adults apartment community.

Materials and methods: After program development, pilot testing was conducted. **Participants:** Older adults ($N = 20$; age 62+) residing in an apartment community. **Procedures:** Collection of baseline objective and self-report measures with a focus on physical activity; administration of the 10-week AFRESH program via weekly sessions; collection of follow-up data 12 and 36 weeks after baseline data collection. **Data analysis:** Descriptive statistics, growth curve analyses.

Results: Significant increases were observed for grip strength (lbs) (T1:56.2; T2:65.0 [$d = 0.77$]; T3:69.4 [$d = 0.62$], $p = .001$), the 6-min walk test (meters) (T1:327m: T2:388.7 m [$d = 0.99$]; T3:363.3 m [$d = 0.60$], $p = .001$), the Rapid Assessment of Physical Activity (RAPA) strength and flexibility score, and the Pittsburg Sleep Quality Index (PSQI) global score. These effects showed some attenuation by the final time point.

Conclusion: By combining novel educational content (bioenergetics), facilitation of physical activity, and habit formation, AFRESH is a multicomponent intervention that shows promise for future research.

1. Introduction

Population aging is occurring at a rapid pace and lifespan is increasing. Globally, by 2050, the number of individuals over the age of 80 will triple from 143 million (2019) to 426 million [1]. Many older adults spend their final years with disability, chronic conditions, and psychological vulnerabilities (depression, decreased wellbeing) [2,3]. Health challenges are especially prominent among socioeconomically disadvantaged groups [4], highlighting the importance of reaching individuals with health information that could lead to behavior change before the loss of physiologic compensatory mechanisms. Our prior work demonstrates that older adults can be unaware of the biological mechanisms contributing to the development of age-related conditions [5]. When made aware, many older adults express a wish to know sooner rather than later so they can employ lifestyle changes to prevent, delay, and/or mitigate the effects of biological aging that leads to frailty [5,6]. Frailty is a state of vulnerability that reflects the slow and gradual loss of strength and energy over time that many older adults face in the last 3–5 years of life [6,7]. Recent publications call for greater public awareness [8,9] to empower older adults to implement holistic approaches to mitigate frailty across the life course with early work focused on staying healthy and proactive lifestyle measures, and later tasks focused of safety, reducing hospitalization, and preparing for end of life [10,11]. Experts in gerontology call for strengthening the role of public health in advancing better health for older adults across the life course [12,13] and for evidence-based multicomponent interventions that include physical activity combined with other components (i.e., health coaching [nutrition, mind/body practices, social engagement]) [14-16].

In response to the need for community-based interventions [17,18], our team developed *AFRESH* (**A**ging and **Fr**ailty: **R**esilience and **E**nergy in the **S**econd **H**alf of Life), a holistic, multi-component intervention, based on a health coaching approach [18,19] and a tested frailty-focused educational communication tool [6,20]. Theoretical underpinnings of AFRESH are

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based on Protection Motivation Theory [21] which posits that components of risk perception trigger cognitive mediating processes that lead to protection motivation and intent to adopt recommended intervention measures. Protection motivation related to perceived risk is a strong predictor of behavior change both in the short term and sustained over time [22,23]; and stage movement (from pre-contemplation [not thinking about it] to action/maintenance) is dependent on threat and coping appraisal [24,25]. AFRESH is a health/wellness program designed to: 1) advance lay understanding of biological aging/bioenergetics and associated risks, 2) promote proactive engagement in a healthy lifestyle with an emphasis on physical activity, 3) empower personal management of one's aging trajectory, and 4) facilitate habit formation. The purpose of this paper is to describe the development of the AFRESH program and to report on pilot testing undertaken in a local apartment community for older adults.

2. Methods

2.1. Program development

Modeled after health coaching interventions targeted to older adults [26,27] we developed the AFRESH program in collaboration with community partners, comprised of a housing organization [28], community networking organization [29], mental health provider, legal aid organization, physical fitness company [30], and Vanderbilt University School of Nursing. Funded by a local, non-profit charitable organization, our community partners began meeting in January 2020 to design a health/wellness program for older adults who would reside in a new apartment community that opened in September 2020. Based on the principal investigator's established frailty-focused communication work [5,6,20], the AFRESH program reflects the input/feedback from stakeholders with vested interest in disadvantaged community-dwelling older adults. The vision of the funder is "aging with dignity" and the mission is to enrich the lives of older adults through funding, advocacy, and community collaboration. We developed AFRESH with this mission in mind.

From January through June 2020, we developed program content for 10 modules, including: a) an opening overview module, b) eight content-specific modules and c) a summary module (see Fig. 1). Introduced in the overview module and integrated throughout the program is content on habit formation [31], energy homeostasis [32], and developing a practical and personal proactive plan for aging in the eight focus areas [33]. Educational content for the eight focus areas were drawn from leading experts and organizations that advocate for older adults (e.g., National Institute on Aging [NIA], National Council on Aging [NCOA]), World Health Organization [WHO]). Supplementary material (Appendix A) provides a summary of educational objectives and content with references for content covered within AFRESH. Focus area content is publicly available material that we consolidated and targeted to older adults. The innovative and emphasized component of the AFRESH program is the content on energy homeostasis to preserve function and prevent frailty. We reiterated this content throughout the program via 2-min boosters at the end of every AFRESH session (Fig. 1).

An overarching objective for mitigating frailty is to equip older adults with a basic understanding of what happens to the human body as it ages in relationship to the body's ability to generate energy. Loss of energy homeostasis leads to declines in both physical and cognitive function and eventual frailty [34]. Advancing understanding of these complex processes at a lay-person level may influence motivation to engage in health promotion behaviors [35]. To reinforce this information, AFRESH also provides prognostication information about frailty to demonstrate the influence of frailty on outcomes after injury (e.g., falls) and hospitalization (disability, functional decline, mortality) [36]. Building on the concept of frailty, AFRESH educates individuals about trajectories of aging that eventually lead to end of life, but also, actions to mitigate the typical trajectory of decline that occurs in many individuals. AFRESH is a multicomponent intervention with physical activity as the cornerstone of the program. Embedded throughout the 10-week program are the concepts of *bioenergetics* and *energy homeostasis* as related to aging and physical activity because our prior work revealed that content about "how the body makes energy" was a motivator of behavior change [6]. Fig. 2 provides a conceptual model of processes of aging that leads to oxidative stress and mitochondrial dysfunction that can be mitigated through physical activity to achieve energy homeostasis and improvements in objective physical measures (gait speed, grip strength) and related self-reported measures (perceived exertion, fatigue).

2.2. Bioenergetics and aging

Foundational to advancing understanding of *energy homeostasis* and *mitochondrial fitness* [37] is the field of bioenergetics, or transformation of energy in living organisms in relationship to aging. Bioenergetics of aging is a rapidly expanding field of science [38] with an increasing number of studies demonstrating the interplay between mitochondrial function and hallmarks of aging such as genomic instability, telomere attrition, epigenetic alterations, intracellular communication, and loss of protein homeostasis [39-42]. A growing body of literature references evolutionary roots of mitochondria and the subsequent interconnectedness with disease states [43-46]. Mitochondrial dysfunction is associated with development of cardiovascular disease/heart failure [47,48], chronic kidney disease [49,50], diabetes [51,52], depression [53,54], cancer [55,56], neurodegeneration [57,58], and even outcomes of COVID-19 [59-61]. Moreover, mitochondrial DNA (mtDNA) copy number (mitochondrial genomes per cell) is a proxy measure for mitochondrial function that is predictive of physical

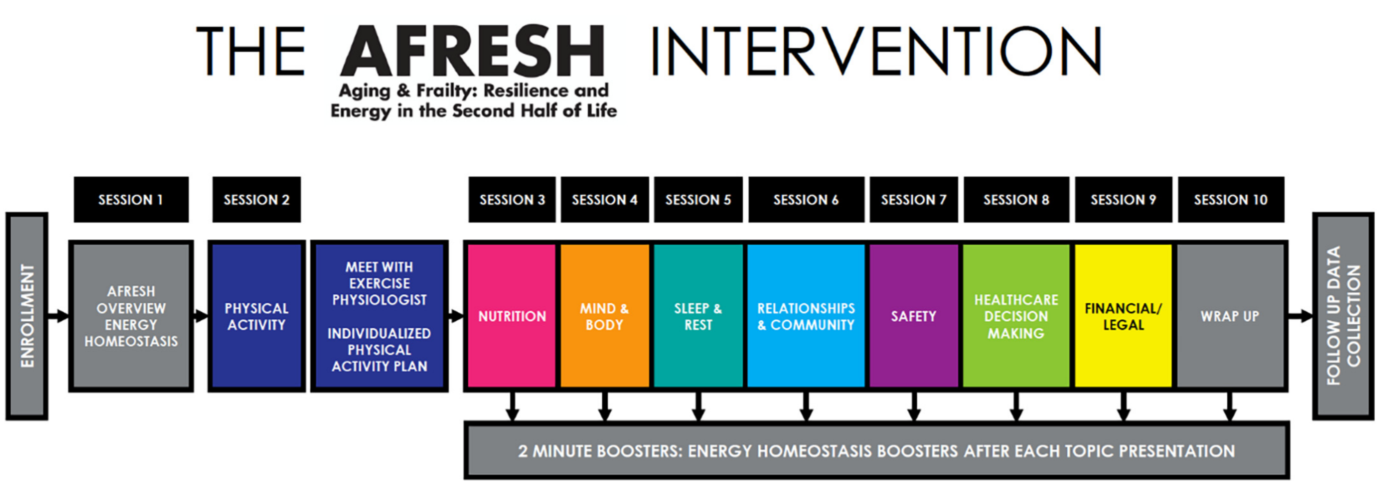

Fig. 1. The AFRESH Intervention: 10 sessions/modules.

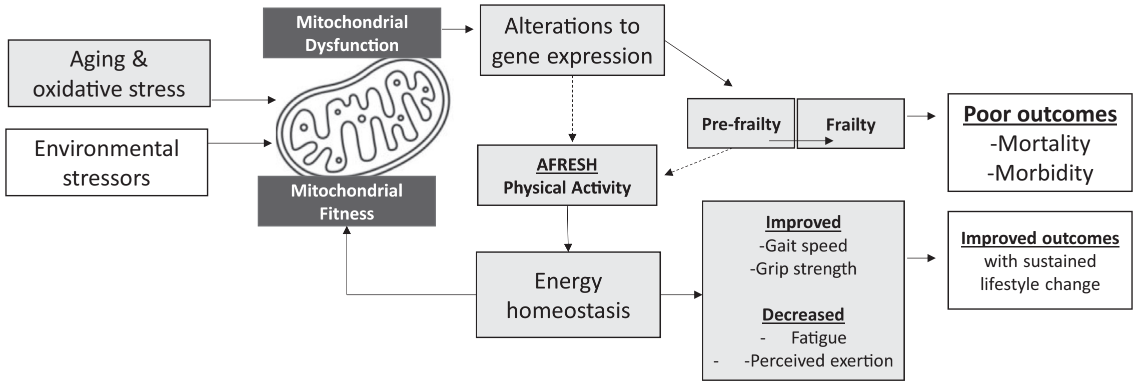

Fig. 2. Conceptual model: Bioenergetics and physical activity as the cornerstone of AFRESH. **gray boxes represent areas addressed through the AFRESH program.

function associated with aging, as well as all-cause mortality [62]. In short, by educating older adults about the importance of personal attention to maintaining the body's ability to generate energy (mitochondrial fitness), AFRESH prompts protection motivation to engage in physical activity (and other healthy behaviors) [24,63]. Physical activity is the leading intervention to prevent, delay, and mitigate mitochondrial dysfunction [64,65]. Large-scale studies and systematic reviews report the benefits of exercise on mitochondrial function and subsequent physical and psychosocial health [66-70]. Supplementary material (Appendix B) includes illustrations utilized in the AFRESH program to educate older adults about mitochondrial dysfunction and energy homeostasis.

2.3. Pilot testing

The newly developed AFRESH program was tested using a quality improvement approach [71] in a newly constructed older adult apartment community. The AFRESH pilot study was approved by the Vanderbilt University Institutional Review Board as a quality improvement project (IRB #201776). The aim of the study was to assess preliminary efficacy of the AFRESH program on primary outcome measures influenced by physical activity (gait speed, grip strength) and secondary outcomes (i.e., self-reported perceived exertion, fatigue, importance of exercise) among disadvantaged older adults living in a local apartment community. We hypothesized that increased physical activity would improve primary and secondary outcomes.

2.3.1. Participants and setting

Older adults residing in a new apartment community were recruited in September 2020 for the AFRESH program which was conducted from October to December 2020. Exclusion criteria included any disability that precluded the ability to walk independently. One person was excluded because of blindness.

2.4. Procedures

2.4.1. Recruitment

After meeting with an onsite service coordinator, new residents were introduced to a member of our study team who followed a standard script to describe the AFRESH program. Upon enrollment, participants signed a waiver of liability for voluntary completion of a 6-min walk test with a certified exercise physiologist. Amidst the need for safety precautions related to COVID-19, AFRESH participants were provided with an Apple™ iPad and were trained on how to access the internet and the Zoom™ videoconferencing program. Follow-up occurred 12-weeks and 36-weeks after baseline. We collected follow-up measures in person from Jan. 4–8, 2021 (T2). We collected follow-up measures again (T3) from June 15, 2021-July 15, 2021.

2.4.2. Intervention

Weekly 1-h AFRESH sessions were conducted on Saturday mornings at 10 am from October 17–December 19, 2020. Sessions consisted of 30 min of didactic (PowerPoint presentation) on the topic of the week, followed by open discussion about practical application of the content for personal goal setting. For example, for the week on nutrition, participants were encouraged to set a daily goal for intake of fruits and vegetables; and a participant might set a goal of eating at least two vegetables every day. Each weekly session concluded with a 2-min booster about bioenergetics to remind participants of the importance of maintaining physical activity to prevent frailty and maintain energy homeostasis. Throughout the 10-week period, the PI (CAM) and exercise physiologist (CR) were available onsite to meet with participants individually (face-to-face) and provide "make-up" sessions if participants were unable to participate via Zoom.

After the first two AFRESH sessions (overview, physical activity), the exercise physiologist (CR) met with each participant one-on-one to design an individualized exercise program consisting of a walking plan and/or use of a recumbent bicycle (onsite), and use of resistance bands for strength training. Individualized plans were based on each participants' baseline status and functional ability. For example, one person set a goal of walking at least 15 min/day or one mile/day while another person was ready to set a goal of 1.0 h or 3 miles/day. Participants were provided with resistance bands, a PI-developed educational booklet on aging and frailty, a workbook containing all AFRESH materials, including presentation slides, exercise tracking forms and supplementary material. After completion of the 10-week AFRESH program, the PI and exercise physiologist continued weekly contact with AFRESH participants to provide encouragement and guidance with individuals' exercise plans. Additional educational sessions were provided monthly by faculty and graduate students who volunteered to present on pertinent topics (e.g., mindfulness meditation, completion of an advance directive, preparing healthy meals, coping with stress).

2.5. Data collection

Data were collected by trained study staff and stored in REDCap, a secure, electronic data capture system [72].

2.5.1. Measures

Demographic information was collected at baseline and included self-report of health conditions and social determinants of health. As outcomes, we chose measures conceptually consistent with the mechanisms of action of the intervention (see Fig. 2) as described above, and included objective measures of physical health and functioning (primary outcomes: body mass index (BMI), grip strength, 6-min walk test (6MWT) [73], Borg Scale of Perceived Exertion) [74], as well as self-report measures (secondary outcomes: engagement in physical activity, Rapid Assessment of Physical Activity (RAPA) [75], and the Chalder Fatigue Scale) [76]. Additional self-report measures were collected, including the Pittsburgh Sleep Quality

Index [77], the Cognitive and Affective Mindfulness Scale [78], and the NIH's Psychological Well-Being [79] items. Objective measures (gait speed [6MWT], grip strength) were collected by the PI and exercise physiologist following published/recommended protocols.

2.6. Data analysis

Data analysis software (the RStudio® IDE with the package LME4) [80,81] was utilized for all analyses. Descriptive statistics include frequencies, percentages, measures of central tendency, and change scores over time, with 95% confidence intervals. We used growth curve modeling (GCM) in a linear mixed effects modeling context. GCM is a sensitive and powerful technique that estimates within-person trajectories of change over time and produces both aggregate (fixed effects) estimates as well as estimates of variability around the fixed effects [82]. We used a model-trimming approach by starting with a model that included all fixed and random effects and then removing non-significant effects one-by-one and evaluating model fit at each stage. Modeling stopped when the change in AIC between the models passed a threshold of 4.0 [83]. We estimated fixed effects for intercept and average change form (both linear and quadratic change). Estimates of variability around the average intercept and growth forms were also estimated. As an exploratory step, when significant variability was found in any of the fixed effects we attempted to model it using available person-level predictors. Because of the small sample size, we explored only 2 potential predictors of random effects (moderators of change): age and sex, and we did not attempt to model variability in quadratic change.

Growth curve modeling is ideal for incomplete longitudinal data with missing values as trajectories are estimated within individuals, based on their own available data points. It has been successfully used in samples as small as 20 [84]. Because growth curve models rely on within- individual data to estimate trajectories, total N is less important than available time- points within individuals. For all outcomes, we report mean (standard deviation) at each time point, as well as the mean difference (standard error of the difference) from the baseline assessment. The mean difference represents the average of actual change over time for cases with available data at those timepoints. As we have missing data due to attrition but also randomly missing data even for cases who completed the follow-up assessments, mean change is not the same as mean values at each timepoint.

Because of the small sample size, we also computed pairwise effect sizes for all measures (between baseline and time 2 and between baseline and time 3 (see Table 2). Because of the exploratory nature of this project, we also report effect size Cohen's 'd' for all outcomes even if the effects were non-significant. Of note, since the study was a quality improvement effort, we did not conduct an *a priori* power analysis. An unadjusted alpha of 0.05 was used for all analyses.

3. Results

Twenty participants (63%) among 32 new residents enrolled in the AFRESH program; characteristics are shown in Table 1. Reported comorbidities among participants included: hypertension ($n = 16$, 80%), depression ($n = 10$, 50%), and obesity (n = 10, 50%). The median number of daily medications was five (IQR: 3.75–9.25). Over the duration of the program, two participants were lost to unavoidable circumstances (traffic accident, COVID-19 hospitalization). Session attendance during the 10-week program ranged from five to 12 participants. If participants missed scheduled videoconference sessions, additional presentations were delivered face-to-face by the PI (CAM). Sixteen participants (80%) provided follow-up data at 12 weeks from baseline, and 12 participants (60%) provided follow-up data at 36 weeks from baseline. Reasons for not providing follow-up data included "no longer interested in the program" and "still interested, but did not wish to be tested."

Table 1
Demographic and health measures of AFRESH pilot study for whole sample and completers.

	Baseline ($N = 20$)	9-Month Follow-Up ($N = 12$)
Age (M,SD)	68.35 (5.82)	68.83 (6.59)
Gender Female (N, %)	9 (45%)	4 (33%)
Race/Ethnicity		
White	4 (20%)	3 (25%)
Black	16 (80%)	9 (75%)
Non-Hispanic	20 (100%)	12 (100%)
Education		
<HS	0 (0%)	0 (0%)
HS or GED	16 (80%)	8(67%)
Some College	4 (20%)	3 (25%)
College Degree	3 (15%)	1 (8%)
Marital Status		
Married	2 (10%)	2 (17%)
Single	7 (35%)	3 (25%)
Divorced/Widowed/Separated	11 (55%)	7 (58%)
Employment		
Retired	12 (60%)	8 (33%)
Part Time	1 (5%)	0 (0%)
Disability	4 (20%)	2 (17%)
Other	3 (15%)	2 (17%)
Insurance		
Medicare	13 (65%)	10 (75%)
Medicaid	15 (75%)	4 (33%)
Private	2 (10%)	1 (17%)

3.1.1. Outcome measures

Differences in the outcome measures from baseline to the first (12-weeks after program initiation) and second (36-weeks post) follow-ups are shown in Table 2.

Results from the growth curve modeling for continuous outcomes are shown in Table 3 (objective outcomes) and Table 4 (self-report outcomes). For all model results in Tables 3–5, interpretation is as follows: β_{00} is the fixed effect intercept, e.g., the average starting value for all patients, β_{10} is the rate of linear change over time (from baseline) for all cases with at least 2 timepoints, and β_{20} is the rate of quadratic change (also centered at baseline). Significant quadratic change indexes any attenuation (slowing or reversal) of linear change. The corresponding random effects (τ_{00}, τ_{10}, τ_{20}) represent variability in the fixed effects and when significant, indicate that the 'average'/fixed effect shows significant differences across cases (e.g., that the effect might be moderated). Significant increases were observed for grip strength, the 6-min walk test, the RAPA strength and flexibility score, and the PSQI global score. For all but grip strength, these effects showed some attenuation by the final time point. There was no moderation of any effects by either participant sex or age.

4. Discussion and conclusion

4.1. Discussion

Although the AFRESH pilot study was a quality improvement project, our reported results are encouraging with this small sample of disadvantaged older adults residing in an age-friendly community. Over a 9-month period, while attenuation occurred, we saw clinically significant improvements [85] in gait speed and grip strength, and self-reports of strength/flexibility training and sleep quality. Improvements in walking distance, grip strength and BMI are promising early indicators of program effectiveness for older adults who participate in a health and wellness program within their own community. Novel components of the AFRESH program (energy homeostasis, habit formation) hold the following implications for future work regarding motivation for behavior change.

The formation of motivation or intention to engage in behavior change is complex, requiring individuals to first become aware of implications of his/her current behavior (e.g., sedentary) and what one must do

Table 2
Descriptive statistics for all outcome measures.

Measure	Baseline (N = 20)	12-weeks (N = 16) M (SD) / Mean Difference (SD_d)	36-weeks (N = 12) M (SD) / Mean Difference (SD_d) (from baseline)
BMI	31.42 (8.87)	30.72 (7.75) / −0.39 'd' = 0.26	32.22 (7.14) / −0.029 (2.49) 'd' = 0.01
Grip Strength	56.17 (19.02)	64.99 (18.58) 8.82 (11.51) 'd' = 0.77	69.42 (20.87) 12.80 (11.51) 'd' = 0.62
6-Minute Walk Test – Walk Distance (meters)	327.60 (120.29)	388.66 (139.11) −61.06 (61.40) 'd' = 0.99	363.32 (136.60) −44.14 (74.01) 'd' = 0.60
6-Minute Walk Test (Post) Perceived Exertion	12.07 (2.12)	12.13 (1.12)/ −0.07 (2.12) 'd' = 0.03	11.00 (1.79)/ −0.83 (1.39) 'd' = 0.64
Chalder Fatigue	13.58 (4.83)	11.00 (5.53)0 .47 (4.56) 'd' = 0.10	10.33 (5.19) 2.18 (3.28) 'd' = 0.66
Exercise Importance *("how important is it for you to engage in physical activity?')*	9.25 (1.12)	9.19 (1.60)/0 .13 (1.78) 'd' = 0.07	9.58 (0.67)/0 .50 (0.80) 'd' = 0.63
Exercise Confidence *('how confident are you about engaging in an exercise program?')*	8.44 (2.19)	8.31 (2.65)/0 .12 (1.99) 'd' = 0.06	7.58 (2.81)/0 .75 (2.60) 'd' = 0.28
RAPA Aerobic Score	2.12 (1.26)	2.00 (1.50)/0 .125 (0.46) 'd' = 0.07	1.42 (0.80)/0 .75 (1.36) 'd' = 0.55
RAPA Strength & Flexibility	0.69 (0.79)	0.58 (0.70)/ −0.63 (0.50) 'd' = 1.25	1.33 (0.65)/ −0.42 (1.16) 'd' = 0.36
PSQI Global	7.94 (4.12)	7.00 (3.94) −0.94 (2.87) 'd' = 0.33	9.83 (5.64) 2.00 (3.54) 'd' = 0.56

'd' is Cohen's d, calculated as mean difference/SD_d.

Table 3
Growth curve modeling of objective outcome measures.

	BMI	Grip Strength	6-min Walk	6-min Walk Test Perceived Exertion (post walk)
Average (Fixed) Effects				
Intercept – Initial Level (β_{00})	32.34***	50.58***	233.06***	11.93***
Linear Change (β_{10})	−0.86	6.23**	115.24**	−0.89±
Quadratic Change (β_{20})	0.11	NE	−21.34*	NE
Variance Components (Random Effects)				
Intercept Variance (τ00)	9.75***	9.90** Sex NS Age NS	121.27*** Sex NS Age NS	7.75*** Sex NS Age NS
Linear Change Variance (τ01)	1.65±	NE	30.77*** Sex NS Age NS	NE
Quadratic Change Variance (τ01)	0.64*	NE	NE	NE

NS = $p > .10$, NE = not estimated in best fit model, ***$p < .001$, ** $p < .01$, * $p < .05$, $^{\pm 0}.10 > p < .05$.
B_{10} = coefficient of linear change, β_{20} = coefficient of quadratic change, τ_{00} = intercept variance, τ_{10} = linear slope variance, τ_{20} = quadratic slope variance.

(e.g., exercise) to alter those implications. Novel AFRESH educational content (bioenergetics, habit formation) reflects pre-motivational factors for behavior change, including: a) knowledge (understanding factual information) and b) cognizance (level of awareness in relationship to personal health), and c) risk perception (perceived susceptibility to a health threat) [86]. Age-friendly environments (e.g., green space, sidewalks, safe housing) with community outreach may also contribute pre-motivational cues (signals one perceives within the environment) that encourage participation in programs like AFRESH [87]. Findings from our study are consistent with recent systematic reviews reporting features of effective physical activity programs for diverse older adults [88,89]. Montayre et al. [87] highlighted the need for close-to-home programs and adaptations of culturally familiar activities. Yarmohammadi et al. [88] reported barriers of physical problems and lack of companions; and motivators as improvements in one's physical condition, being social, and suitability of the physical environment.

From a broader and pragmatic perspective, community collaboration and the practical design of the AFRESH program provided a foundation for success of the pilot project. A range of community stakeholders and advocates, from housing, mental health, physical fitness and others met bi-weekly with a common goal to improve health and quality of life for disadvantaged older adults. We recognize that use of an exercise physiologist could be cost prohibitive for a public health intervention. We intend to explore and test other scalable options (e.g., video demonstrations of exercise, use of volunteers) to promote physical activity in AFRESH that lead to behavior change. Also, while we are unable to identify exact motivators of

Table 4
Growth curve modeling of self-report outcome measures.

	RAPA Aerobic	RAPA Strength/Flexibility	PSQI	Borg Scale
Average (Fixed) Effects				
Intercept – Initial Level (β_{00})	2.19***	−0.87*	7.74***	9.17***
Linear Change (β_{10})	−0.63 ±	2.23**	7.0***	0.13
Quadratic Change ($\beta 2_0$)	NE	−0.53*	−2.38**	
Variance Components (Random Effects)				
Intercept Variance (τ00)	0.36	NE	1.29*** Sex NS Age NS	0.66**
Linear Change Variance (τ01)	NE	1.19*** Sex NS Age NS	NE	NE
Quadratic Change Variance (τ01)	NE	0.16*** Sex NS Age NS	NE	NE

NS = p > .10, NE = not estimated in best fit model, ***p < .001, ** p < .01, * *p* < .05, $^{\pm 0}$.10 > *p* < .05.
β_{10} = coefficient of linear change, β_{20} = coefficient of quadratic change, τ_{00} = intercept variance, τ_{10} = linear slope variance, τ_{20} = quadratic slope variance.

behavior change, several possibilities hold implications for future research, as well as rehabilitation success with older adults. For instance, our novel content on energy homeostasis related to aging helps older adults understand not only the importance of exercise, but also the consequences of failure to sustain regular physical activity over time. Content on *habit formation* and *ongoing support from the study team* may have enhanced motivation. By teaching older adults about the science of habit formation, AFRESH helps individuals work on habit development **before** focusing on intensity of a specific action [34]. Additionally, relationship building between participants and the project team, as well as group interaction with other participants may have contributed ongoing engagement over the 9-month period.

The AFRESH pilot study had limitations, including the small sample size, missing data and a quality improvement vs. research approach. The project was funded to introduce AFRESH at a single site, thus, limiting our ability to expand the sample. Literature supports the use of pilot studies to determine feasibility and to find early signals of efficacy [90]. We consider this pilot as a requisite step in exploring our novel intervention before seeking larger funding for a full scale clinical trial. Since the pilot was deemed quality improvement (QI), we were not bound by the rigors of research, which can be both a limitation and strength. As with pragmatic clinical trials that allow for evaluation under normal circumstances, the benefit of our QI approach allowed us to respond to barriers and challenges in real time and real-world application. For example, we were able to address technology challenges by one-on-one delivery of AFRESH content to individuals, and we were able to be responsive to needs as they arose (e.g., instructions on recumbent bicycle, referrals for community resources) of participants throughout the project. Another limitation related to our AFRESH conceptual model (Fig. 2) is that we did not examine the influence of environmental stressors on mitochondrial fitness and/or outcomes of the study. Such stressors includes food availability, air quality, temperature, outdoor walking spaces, and built environment. Scientific literature describes the importance of age-friendly environments for optimizing health, pointing out that mitochondria regulate cell danger response to environmental factors [91]. Considering our small sample size, we did not address this, however, future work will include this critically important topic.

4.2. Innovation

The AFRESH intervention is innovative in its approach to addressing intrinsic motivation. Intrinsic motivation is a concept that involves both goal attainment (end product) and specific perceptions elicited by an activity [92]. Such perceptions include affective (emotions one feels), cognitive (mental processing) and behavioral (ability, habits) factors. Health and wellness programs targeted to older adults must address these factors to be successful. Focusing on proximal benefits (vs. distal) strengthen individual's self-regulatory self-efficacy [92]. As a multicomponent intervention for aging adults, AFRESH focuses on proximal benefits of exercise (increased energy, decreased fatigue) by highlighting the importance of daily attention to energy homeostasis or the need for regular engagement in moderate to vigorous physical activity. Educational components of AFRESH emphasize the connection between ongoing physical activity and maintenance of the body's 'energy engines' to prevent decline, development/delay of chronic conditions, and frailty. Comments about AFRESH educational content by an older adult reflects this fusion of affective, cognitive and behavioral perceptions with an understanding of the end product [4]. For example:

> "…I appreciate the wake-up call because I could've waited until it (physical condition) was even worse. But it was good to know that you can, if you're prepared, go ahead and make some of these adjustments…, that it's not too late because it's like that expression, "you either use it or lose it."" [5 (p.15)]

Other components of AFRESH content also address proximal benefits. For example, the *nutrition* focus area emphasizes the need for daily water intake to relieve constipation, cushion the brain, and flush body waste, etc. By reporting outcomes after a fall, the *safety* focus area emphasizes the need for constant vigilance in avoiding injury to prevent functional decline. The *mind/body health* focus area helps individuals to make the connection between thought processes and negative emotions (worry, feelings of stress, anger) and effects on various body systems (brain [depression, anxiety], cardiovascular [high blood pressure, high cholesterol], gastrointestinal [indigestion, bloating, pain]).

4.3. Conclusion

The AFRESH health and wellness program for older adults targets community-dwelling individuals age 50 and older and enhances understanding of what is happening to the human body as it ages from the perspective of energy homeostasis. AFRESH empowers individuals to make a proactive plan for aging and prevention of frailty. By combining novel content (energy homeostasis), focus areas specific to aging, and other

Table 5
Growth curve modeling of self-report outcome measures.

	Well Being	CAMS	Exercise Importance	Exercise Confidence	Chalder Fatigue
Average (Fixed) Effects					
Intercept – Initial Level (β_{00})	103.83***	8.68***	9.15***	8.66***	8.59***
Linear Change (β_{10})	−6.9±	0.13	0.14	−0.34	−1.06±
Quadratic Change ($\beta 2_0$)	NE	NE	NE	NE	NE
Variance Components (Random Effects)					
Intercept Variance (τ00)	6.16±	1.98***	0.19*	2.32***	19.16***
Linear Change Variance (τ01)		0.99***	NE	NE	NE
Quadratic Change Variance (τ01)	NE	NE	NE	NE	NE

NS = p > .10, NE = not estimated in best fit model, ***p < .001, ** p < .01, * p < .05, $^{\pm 0}$.10 > p < .05.
β_{10} = coefficient of linear change, β_{20} = coefficient of quadratic change, τ_{00} = intercept variance, τ_{10} = linear slope variance, τ_{20} = quadratic slope variance.

facilitators (habit formation, ongoing support), AFRESH is a multicomponent intervention that shows promise for ongoing work by our team. Future research will advance this work on a larger scale with attention to intervention fidelity and understanding effectiveness of individual elements of the program.

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Statement regarding conflicts of interest

The authors of this manuscript have no conflicts of interest or declarations related to the submitted work.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pecinn.2022.100084.

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